

Advanced Java Programming

Week 5 Topic Outline

Data Structures

1. What is a data structure?
 - a. An implementation of an abstract data type
 - b. Implementations rely on only 2 operations:
 1. Contiguous memory allocation
 2. Memory references (pointers).
2. How can we implement a list?
 - a. Mutable array
 - b. Linked list (singly linked, doubly linked)
3. How can we implement a stack?
 - a. Singly-linked nodes pointing from top to bottom.
 - b. External pointer to top node.
4. How can we implement a queue?
 - a. Singly-linked nodes pointing from head to tail.
 - b. External pointers to both head and tail.
 - c. Insert at tail, remove from head.
5. How can we implement a map?
 - a. Hash table where hash function yields index and value is stored in array.
6. How can we implement a bounded set?
 - a. Boolean array (can also bit-pack)
7. How can we implement an unbounded set?
 - a. Naive implementation: use a list. Requires $O(n)$ for basic `insert`, `remove`, `contains` operations.
 - b. Use a hash table, storing the element itself.
8. How can we implement a sorted set?
 - a. Linked list + Hash table if we only care about insertion order

- b. Binary search tree if we care about sorted order
- 9. Ponder: how can we implement a tuple? Not so easy...

Java's Collection Framework

Iterable

Collection

AbstractCollection

List

AbstractList

ArrayList

Stack

AbstractSequentialList

LinkedList

Queue

AbstractQueue

PriorityQueue

Deque

ArrayDeque

LinkedList

Set

AbstractSet

HashSet

LinkedHashSet

TreeSet